5 GREEN VACANCIES BY OCCUPATION

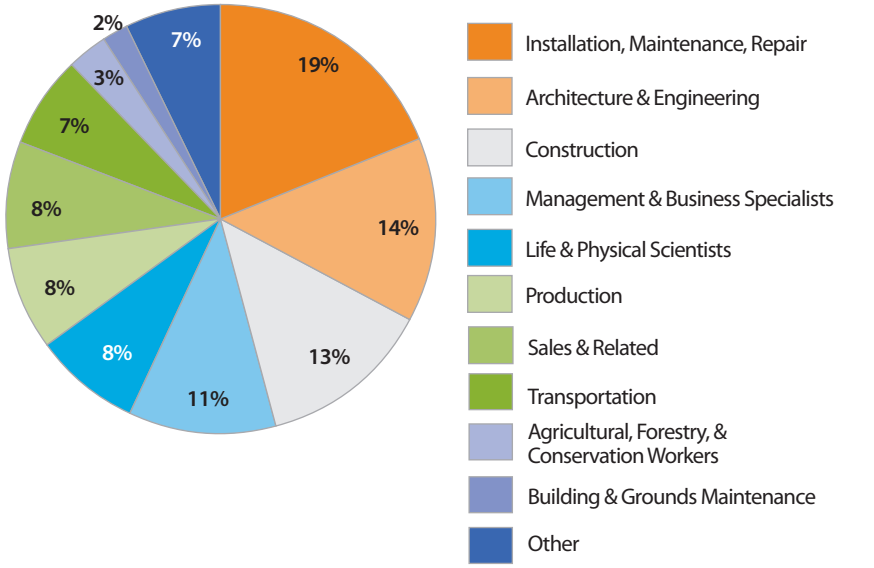
The greening of Minnesota's economy is most clearly observable at the occupational level where new green tasks are being added to traditional occupational tasks. When green-related tasks, often in the form of a practice or project,[9] become more than simply occasional and begin to require additional and/or unique preparation, green jobs start differentiating themselves from non-green jobs within the same occupation. Through meticulous work, green-related tasks were captured one job vacancy at a time in order to identify potential shifts in workforce competencies as the amount of time dedicated to these tasks increases.

[9] The project-driven nature of some green activities is also one of the reasons why green jobs are so hard to identify and so dynamic in nature. An architect can work on a LEED-certified project today and on a traditional construction project tomorrow.

FIGURE 11

Green Vacancies by Occupational Group

Source: Green addendum to MN JVS, 2009-2011



Green Vacancies by Broad Occupational Group

Recent hiring for green jobs has been dispersed across 150 occupations with nearly half concentrated in three major occupational groups: Installation, Maintenance, and Repair; Architecture and Engineering; and Construction. (See Figure 11)

Installation, Maintenance, and Repair

Repair and maintenance services are needed everywhere in the green economy, but predominantly they contribute to energy efficiency by operating, installing, replacing, and fixing systems such as furnaces, boilers, HVAC systems, and factory equipment to optimize their use. Even the most energy efficient building or equipment can rapidly lose its operative efficiency unless properly maintained and monitored.

Green task examples are:

- Install and fine-tune HVAC and building control systems for energy efficiency;
- Monitor energy savings and track energy consumption in Facilities Management Systems (FMS) to ensure continuous energy efficiency gains;
- Maintain green equipment such as geothermal heat units and methane boilers;
- Repair and operate heavy equipment to processes municipal waste for use in energy generation;
- Ensure proper functioning of wind turbines.

As shown in Figure 12, the occupations where most green vacancies were found during the study period are projected to grow over the next eight years.

FIGURE 12

Installation, Maintenance, and Repair Occupations with the Most Green Vacancies by Standard Occupational Classification

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
499021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$24.35	16.2%	Postsecondary vocational training
499081	Wind turbine technician (NEW code)	NA	NA	NA
491011	First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	$28.95	0.6%	Work experience in related occupation
499041	Industrial Machinery Mechanics	$22.21	8.0%	Long-term on-the-job training (> 12 months)
499071	Maintenance and Repair Workers, General	$18.58	11.1%	Moderate-term on-the-job training

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

Architecture and Engineering

Both in terms of hiring demand and range of roles they are asked to play, engineers are the backbone of the green economy in Minnesota. Where there is new technology there are engineering issues about how to incorporate it in designs to ensure manufacturability, quality, and performance, ultimately determining product adoption in the marketplace. Engineers can assume roles as varied as identifying innovative solutions to one-of-a kind technical problems and educating the customer about the long-term environmental benefits of such solutions. Finally, engineers are increasingly invited to the table early in a green project, as in the case of a mechanical engineer whose role in a construction/retrofit project starts with the initial design stage and extends after the life of the building.

Green tasks examples are:

- Incorporate emission control technologies or hybrid/battery systems in vehicles;
- Design green infrastructures, defined as technologies and practices that use natural systems to provide utility services while protecting sensitive waters. Examples are water supply and stormwater management infrastructures;
- Prepare environmental assessments of properties to check for contamination and identify what it would take to clean it up;
- Design and implement lean production processes;
- Design for manufacturability of a new green product.

Architecture and engineering occupations are likely to experience a gradual shift in workforce competencies because of the greening of the economy. In fact, this occupational group is more likely than others to need additional on-the-job training or certification to work on green-related projects. Examples of emerging green certifications are Leadership in Energy and Environmental Design (LEED) and Certified Energy Manager (CEM).

See Figure 13 for wage, job growth, and educational requirements of these occupations.

FIGURE 13

Architecture and Engineering Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
172081	Environmental Engineers	$38.25	17.7%	Bachelor's degree
172141	Mechanical Engineers	$36.05	-0.3%	Bachelor's degree
172071	Electrical Engineers	$39.85	-1.3%	Bachelor's degree
172041	Chemical Engineers	$36.85	-8.9%	Bachelor's degree
172112	Industrial Engineers	$36.88	11.9%	Bachelor's degree
173025	Environmental Engineering Technicians	$20.86	16.6%	Associate degree
171011	Architects, Except Landscape and Naval	$35.55	11.5%	Bachelor's degree
173013	Mechanical Drafters	$23.87	-7.4%	Postsecondary vocational training

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

Construction

Several construction occupations might see increased hiring as demand for energy efficiency and infrastructure construction services grows, such as construction of light rail transit lines or electrical power lines connecting wind turbines to the power grid.

Green tasks examples:

- Install insulation and other energy-efficient features, choosing the appropriate construction materials to enhance efficiency gains;
- Install electrical wiring for geothermal heat systems, energy-efficient HVAC equipment, and lighting systems;
- Cleanup, handle, and move hazardous materials.

Green tasks for construction workers typically do not require any enhanced skills beyond foundational skilled trade competencies. In other words, there may very well be an increase in the amount of time dedicated to green tasks, but it is unlikely to change the nature of the work.

As illustrated in Figure 14, the occupations that generated the highest number of green vacancies from fall 2009 to spring 2011 are all projected to grow over the next eight years.

Management and Business Specialists

This occupational group is critically important for the future of the green economy because of the role it plays in market creation, customer education, organizational development, and regulatory compliance. The impetus for the greening of a firm often starts at the top, either from visionary leaders who see in green products/services an opportunity to improve the firm's environmental standing, or from centralized business functions that champion the cultural and organizational changes inherent in a sustainability agenda.[10] Corporate-level goals can vary widely, from voluntarily becoming more energy-efficient to staying in compliance with stricter environmental regulations.

Green tasks examples are:

- Analyze demand and customer requirements for new product development in emerging green markets;
- Engage in business development and commercialization of new green products and technologies;
- Develop and promote corporate sustainability planning and reporting;
- Apply environmental cost accounting;
- Implement a regulatory strategy for the company to comply with rules in all environmental areas (air, water, waste, hazardous materials, transportation);
- Oversee governmental restoration programs for prairies, wetlands, and forests, including legislative strategy and policy development;
- Oversee chemical/toxicological analysis and regulatory reviews of raw materials to ensure they are in compliance with safety and environmental regulations;
- Train other employees in waste minimization practices such as LEAN.

FIGURE 14

Construction Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
472181	Roofers	26.20	9.8%	Postsecondary vocational training
472111	Electricians	29.88	5.9%	Long-term on-the-job training (> 12 months)
474041	Hazardous Materials Removal Workers	28.57	4.3%	Moderate-term on-the-job training (1-12 months)
472152	Plumbers, Pipefitters, and Steamfitters	29.89	11.9%	Long-term on-the-job training (> 12 months)
471011	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	30.60	14.9%	Work experience (in related occupation)

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

[10] Green is fundamentally about improved environmental attributes of products and services, while sustainability embraces economic and social elements. Sustainability means ensuring that all future citizens have the opportunity to enjoy lives as rich and meaningful as our own, and in a natural environment that is at least as clean, intact, and healthy as that which we enjoy today (sustainability definition used by the Minnesota 2050 Project and the Minnesota Statewide Conservation and Preservation Plan, 2008).

Business operations specialists have the highest concentration of new green job titles, often reflecting the emergence of new green subspecialties such as:

- Regulatory Affairs Managers
- Environmental Compliance Managers
- Lean Supply Chain Managers and/or Logistics Analysts
- Green Marketers
- Wind Energy Project Managers
- Remediation Project Managers
- Energy Auditors
- Sustainability Specialists
- Water Resource Specialists

These sub-specialties, identified by O*NET[11] as "New and Emerging Green Occupations," do not fit very well in the existing Standard Occupational Classification taxonomy. Therefore, they are captured in the residual categories "Managers, All Other" and "Business Operations Specialists, All Other" (see Figure 15).

Life and Physical Scientists

All sectors of the green economy need scientists, not only to conduct laboratory research but to get it out of R&D and into production. Furthermore, life and physical scientists are brought on board to assist engineers, architects, construction managers, and technicians with the aim of incorporating ecological concepts into the built environment, landscape design, and remediation design. The shift in emphasis from end-of-pipe treatment methods to prevention of environmental problems and "green remediation" technologies further increases hiring demand for people with science degrees and related experience. They participate in projects as varied as construction, remediation, civil engineering, and land management to ensure that all of the natural resources involved are treated sensitively.

An emerging area of activity for life scientists is the "green product certification" process through eco-toxicological and/or regulatory reviews. These activities are essential to the scale-up and commercialization of innovative green products.

Green tasks examples:

- Conduct scientific characterization of natural resources (soil, underground water);
- Conduct laboratory tests for contamination and pollution in water and air samples;
- Evaluate product ingredients for long-term sustainability advantages in the market;
- Establish regulatory strategies for new product approval and identify analytical tests that need to be conducted to obtain such approval (for example, testing in compliance with the Environmental Protection Agency).

FIGURE 15

Management and Business Specialists Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
112021	Marketing Managers	$55.58	8.6%	Work experience, plus bachelor's or higher degree
113071	Transportation, Storage, and Distribution Managers	$38.78	-8.1%	Work experience in related occupation
119041	Architectural and Engineering Managers	$56.02	-1.6%	Work experience, plus bachelor's or higher degree
119199	Managers, All Other	$47.72	7.0%	Work experience in related occupation
119121	Natural Sciences Managers	$51.73	11.3%	Work experience, plus bachelor's or higher degree
131199	Business Operations Specialists, All Other	$25.17	8.0%	Bachelor's degree

Source: Occupational Employment Statistics Survey, Fourth Quarter 2010
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

[11] The Occupational Information Network (O*NET), a program of the U.S. Employment and Training Administration, is an online database intended to contain all the jobs that exist in the United States. The O*NET occupational taxonomy is compatible with the SOC taxonomy but it is more comprehensive, identifying and describing over 950 occupations. To access O*NET information on the green economy see http://www.onetcenter.org/green.html?p=2

Figure 16 indicates the occupations where most green vacancies were found, and shows their excellent long-term employment outlook.

Production

Only a very small number of production occupations met the study's definition of green jobs. This finding, seemingly in contradiction with industry findings that identified manufacturing as a major source of green hiring activity, is explained by the fact that production jobs make up a smaller share of employment in the manufacturing sectors where green jobs are most likely to be found. Advanced manufacturing, for instance, is also likely to employ a higher percentage of engineers and a lower percentage of production-floor jobs compared to less advanced manufacturing industries. For example, engineers make up 21 percent and production occupations make up 30 percent of employment in electronic instrument manufacturing. This pattern is also related to the use of automated production equipment that substitutes labor and to the intensity of technology embedded in the products.

Besides being employed in manufacturing, some green production jobs are found in other industries such as large utility plants, hospitals, and building facilities.

FIGURE 16

Life and Physical Science Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
191031	Conservation Scientists	$27.88	6.8%	Bachelor's degree
192041	Environmental Scientists and Specialists, Including Health	$27.24	15.4%	Master's degree
192031	Chemists	$33.95	3.9%	Bachelor's degree
194091	Environmental Science and Protection Technicians, Including Health	$20.20	27.0%	Associate degree
194093	Forest and Conservation Technicians	$16.19	5.8%	Associate degree
192042	Geoscientists, Except Hydrologists and Geographers	$32.99	17.9%	Master's degree
192043	Hydrologists	$32.48	5.4%	Master's degree
191013	Soil and Plant Scientists	$29.50	3.1%	Bachelor's degree
194021	Biological Technicians	$21.93	20.3%	Bachelor's degree
191023	Zoologists and Wildlife Biologists	$25.91	3.7%	Bachelor's degree

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

FIGURE 17

Production Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
511011	First-Line Supervisors/Managers of Production and Operating Workers	$25.40	-5.1%	Work experience in related occupation
519399	Production Workers, All Other	$13.24	-0.3%	Moderate-term on-the-job training (1-12 months)
512099	Assemblers and Fabricators, All Other	$12.81	6.4%	Moderate-term on-the-job training (1-12 months)
518021	Stationary Engineers and Boiler Operators	$26.15	8.7%	Long-term on-the-job training (> 12 months)
518031	Water and Liquid Waste Treatment Plant and System Operators	$22.58	14.5%	Long-term on-the-job training (> 12 months)

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

Green tasks examples include:

- Separate recyclable from non-recyclable material in a recycling plant;
- Operate and troubleshoot machines predominantly used to make green products, for example water filtration membranes;
- Monitor and operate machinery and pumps in municipal wastewater treatment facilities;
- Operate and ensure efficient use of boilers.

Since green tasks for production workers are, for the most part, traditional tasks that happen to be essential to a green product, neither work content nor occupational competencies are likely to change over time as an effect of the greening of the economy. See Figure 17 for a list of these occupations.

Sales and Related

Sales occupations meet the definition of green job only if directly engaged in the promotion, sale, or commercialization of a green product/service. With their innovative and often technical nature, the sale of many green products requires specialized knowledge in order to demonstrate the product's benefits to the customer and to obtain constant feedback on product uses and areas of improvement. The occupation most commonly engaged in consultative sales for technical products are technical sales representatives.

Green tasks examples include the following:

- Identify and develop new business opportunities within assigned accounts and develop business relationships;
- Determine prices of merchandise and assist customers in re-sale store;
- Solicit contributions and educate people about environmental issues such as clean water.

Figure 18 indicates the occupations where most vacancies were found.

Transportation

Green jobs in transportation are very rare, because merely transporting a green product is not a green activity.

Green tasks examples include the following:

- Collect recyclable materials from residential homes and transport them for recycling to a material recovery facility;
- Drive a public bus (not including school buses) or passenger train.

Figure 19 displays these occupations.

FIGURE 18

Sales and Related Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
414011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$39.27	2.9%	Work experience (in related occupation)
411011	First-Line Supervisors/Managers of Retail Sales Workers	$15.89	4.5%	Work experience in related occupation
419099	Sales and related Workers, All Other	$21.19	4.6%	Moderate-term on-the-job training (1-12 months)

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

FIGURE 19

Transportation Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
533021	Bus Drivers, Transit and Intercity	$15.34	5.5%	Moderate-term on-the-job training (1-12 months)
537081	Refuse and Recyclable Material Collectors	$16.76	26.4%	Short-term on-the-job training

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

Agricultural, Forestry, and Conservation

These are predominantly government forest service jobs and farmers/growers committed to organic and sustainable practices. Since most people employed in these occupations have always performed green tasks, they will not experience a transformation in competencies as an effect of the greening of the economy.

Green tasks examples include:

- Planting, harvesting, and packing organic produce;
- Oversee the implementation of government programs to conserve, protect, and enhance fish, wildlife, and plants and their habitats;
- Supervise foresters and enforce Minnesota statutes surrounding forestry resource management.

Figure 20 displays these occupations.

Building and Grounds Maintenance

Green jobs in this occupational group primarily perform manual labor to protect the natural environment (see Figure 21). Groundskeeping work performed for predominantly aesthetic purposes, like growing flowers and non-native plants or maintaining golf-turf grass, or through the use of harmful pesticides, does not qualify as environmentally beneficial.

Green tasks examples include:

- Forestry restoration work such as tree planting, seeding, erosion control methods, brush cutting, prescribed burns;
- Prairie restoration work including mapping and assessing invasive species, applying herbicides, implementing biological control programs, maintaining mowers and other equipment.

FIGURE 20

Agricultural, Forestry, and Conservation Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
454011	Forest and Conservation Workers	$11.65	NA	Moderate-term on-the-job training (1-12 months)
452092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	$10.99	5.9%	Not Available
452099	Agricultural Workers, All Other	$11.25	11.2%	Not Available

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

FIGURE 21

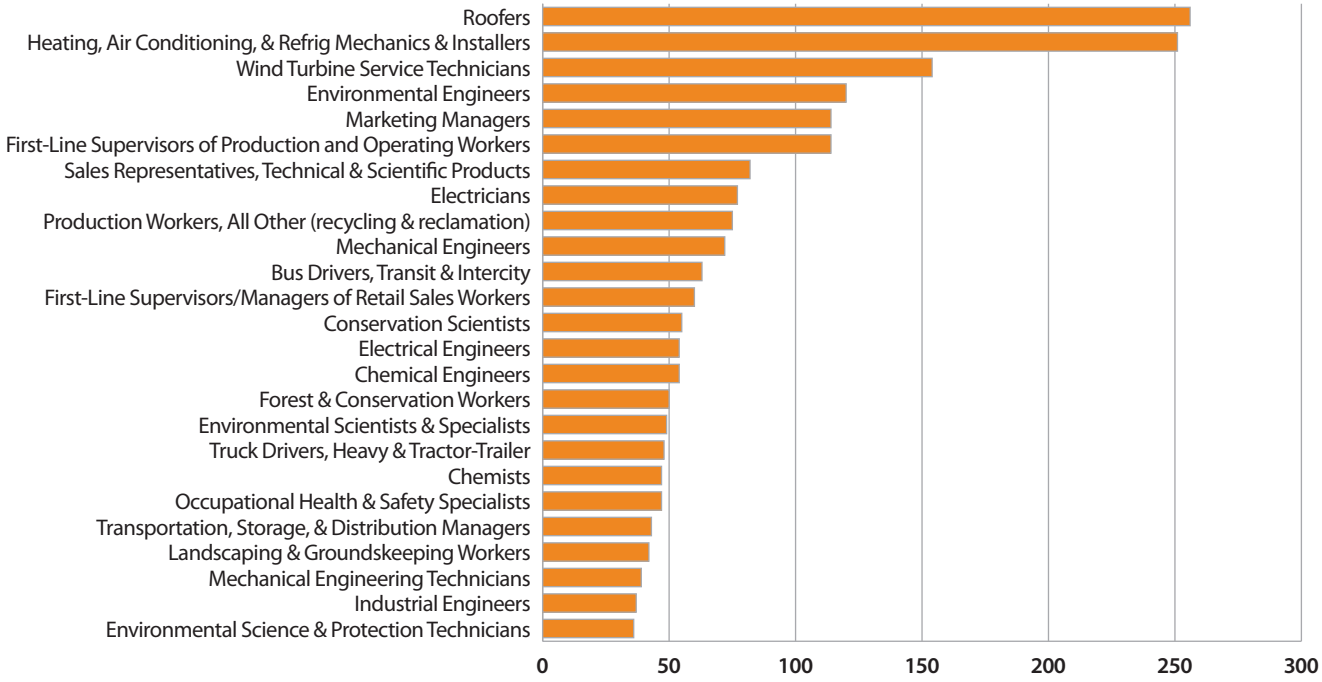
Building and Grounds Maintenance Occupations with the Most Green Vacancies

SOC Code	SOC Title	Median Hourly Wage*	Projected Growth**	Most Common Level of Education***
373011	Landscaping and Groundskeeping Workers	$12.36	15.3%	Short-term on-the-job training
371012	First-Line Supervisors/Managers of Landscaping, Lawn Service, and Groundskeeping Workers	$22.41	18.7%	Work experience in related occupation

**Source: Occupational Employment Statistics Survey, Fourth Quarter 2010*
*** Source: Long-term Employment projections, 2009-2019*
****Source: BLS Employment Projections, 11 Educational Category System*

FIGURE 22

Green Vacancies for Top 25 Occupations



Green Vacancies by Detailed Occupation

Figure 22 lists occupations that produced the most green job openings, aggregating results from four survey rounds. These occupations alone accounted for 52 percent of estimated green job vacancies in Minnesota.

Green activities are an integral part of work performed in occupations like wind turbine technicians, environmental engineers, conservation scientists, forest and conservation workers, and environmental science and protection technicians. The majority of jobs in these occupations are green. On the other hand, occupations like marketing managers and mechanical engineers include workers who, for the most part, do not meet the conservative definition of a green job adopted in this study either because they do not perform green tasks or do not perform them full time. In these occupations, greenness is often a transitional characteristic that depends on how much time happens to be spent on a specific project, product, or service. This is one of the reasons why green jobs are so hard to measure and so dynamic in nature.